Observations on Two Different Forms of *Utricularia reniformis*

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Introduction

The species *Utricularia reniformis* A.St.Hil. is occasionally grown by specialists, who appreciate its large leaves and spectacular flowers. I have observed two different forms of this plant in our collection, and hoped to learn more about it in the literature. Merl (1915) noted there were different sized types of this plant, however Taylor (1989) considered the two types merely to be extremes of species variation. As such, Taylor did not consider them separate species (nor did he accept subspecific taxa in the genus).

Since these plants are of interest to horticulturists, I helped register cultivar names for these two plants (see Rice & Studnicka (2004), for precise details on their differences). The larger plant is called *Utricularia reniformis* 'Big Sister', the smaller is called *Utricularia reniformis* 'Enfant Terrible'.

In this paper, I present new observations about these two cultivars. These observations support the possibility that the two cultivars may be selections from distinct species, and that *Utricularia reniformis* as described in Taylor (1989) may actually be more than one species.

Material and Methods

In all genera of carnivorous plants, the carnivorous trapping organs are generally the most specialized and modified organs. This specialization, so useful in taxonomy, is clearly evident in the large carnivorous plants such as *Nepenthes* and *Sarracenia*, but it is also expressed in the small bladders produced by *Utricularia* species (Thor, 1979; Taylor, 1989; Jobson & Albert, 2002). In this study, living bladders produced by the two plants *Utricularia reniformis* 'Big Sister' and *Utricularia reniformis* 'Enfant Terrible' were examined under a microscope for differences and general characteristics. Plants of three provenances were investigated: 1) *Utricularia reniformis* 'Big Sister', cultivated in the Botanic Gardens of Liberec, Czech Republic, natural origin undetermined; 2) *Utricularia reniformis* 'Enfant Terrible', cultivated in the Botanic Gardens of Liberec, Czech Republic, natural origin undetermined; 3) *Utricularia reniformis* 'Big Sister', studied on 12 December, 2000 in situ in Brazil, Serra dos Órgãos, Pedra do Sino near Teresopolis, 1750 m above sea level. The types #1 and #2 were established in the same planting medium[1], and were grown in pots with apertures in the pot walls to enable the plants to grow from the pot into surrounding water.

Bladders were extracted from the soil and water and observed. Leaf epidermis layers were also observed and compared. Comparative results of the bladder and epidermis observations are discussed below.

Variations in Bladder Structure

There are striking inconsistencies in the published drawings of the bladders of *U. reniformis* (see Figure 1). According to Taylor (1989) the trap bears short, relatively stout recurved antennae, similar to those in traps of epiphytic species like *U. alpina, U. endresii*, etc. This type of traps are probably specialized to fluctuating moisture levels. I designate this trap as an "epiphytic

[1]The planting medium consisted of equal parts of peat moss, 1 cm chunks of polystyrene, and pieces of poplar bark and beech leaves (*Populus nigra* and *Fagus sylvatica*, respectively).

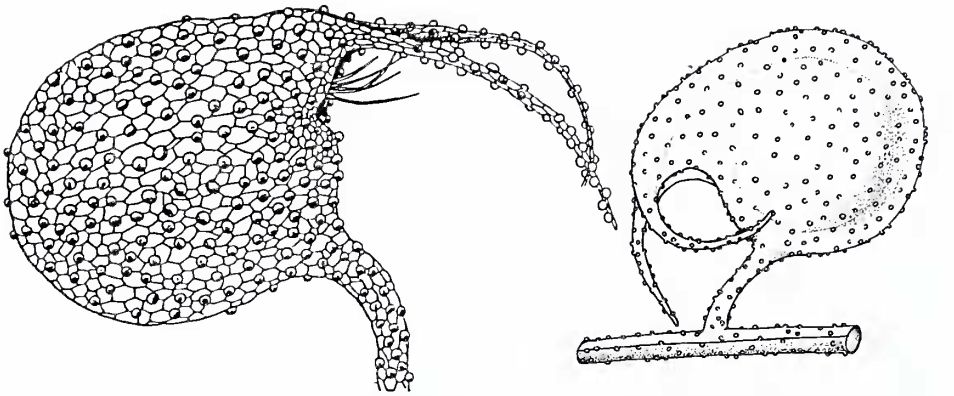

Figure 1: *Utricularia reniformis* bladder drawings in literature: left, from Luetzelburg (1910); right, from Taylor (1989, Figure 131/9 redrawn by R. Novotná). The vesicles of *Utricularia reniformis* are different in position of antennae and exposition of trap entrances (an "aquatic" and an "epiphytic" trap).

bladder." In contrast, the bladder illustrated by Luetzelburg (1910) bears long, slender antennae reflexed away from the bladder entrance, much like as often seen in aquatic species. These traps are apparently adapted to a fully aquatic existence and, if they are situated in soil, to the presence of gravitational water (that is, water not predominantly bound by capillary effects between soil particles). I designate this trap as an "aquatic bladder."

Bladders of *Utricularia reniformis* 'Big Sister' are all of the aquatic form. Figure 2a shows a representative bladder of this plant from an aquatic shoot. The bladder antennae are nearly as long as in Luetzelburg's illustration. Note that antennae are reflexed away from the bladder opening. Bladders of this plant extracted from soil have shorter antennae (see Figure 2b), however they are still recurved from the trap opening (or at least do not strongly curl around the front of the bladder) and so I still classify them as the aquatic form. All the bladders of *Utricularia reniformis* 'Big Sister,' regardless of their various sizes or locations in the environment, have antennae that are deflected from the bladder entrances.

Bladders of *Utricularia reniformis* 'Enfant Terrible' located in the soil are of the epiphytic form (see Figure 2d). The antennae are strongly curved around the bladder opening. The aquatic shoots of this plant, which are never so pronounced as the aquatic shoots of *Utricularia reniformis* 'Big Sister,' are also predominantly equipped with epiphytic bladders. Nevertheless, one can occasionally find large, aquatic bladders bearing the characteristically long antennae (see Figure 2c). These antennae are curved away from the bladder opening.

Leaves and Heterophylly

As discussed in the article that establishes the cultivar names *Utricularia reniformis* 'Big Sister' and *Utricularia reniformis* 'Enfant Terrible' (see Rice & Studnicka, 2004), the former plant produces large leaves while the latter produces both medium leaves and minute to small ground leaves (see also Merl, 1915).

In addition to the primary differences between these two plants that are noted in the cultivar descriptions, I have observed differences in the epidermal features (see Figure 3). All the leaves of *Utricularia reniformis* 'Big Sister' (see Figures 3a-b), and the medium leaves of *Utricularia reniformis* 'Enfant Terrible' (see Figures 3c-d) bear stomata only on the lower surface. In contrast, the ground leaves of *Utricularia reniformis* 'Enfant Terrible' bear stomata on both the lower and upper surfaces (see Figures 3e-f)!

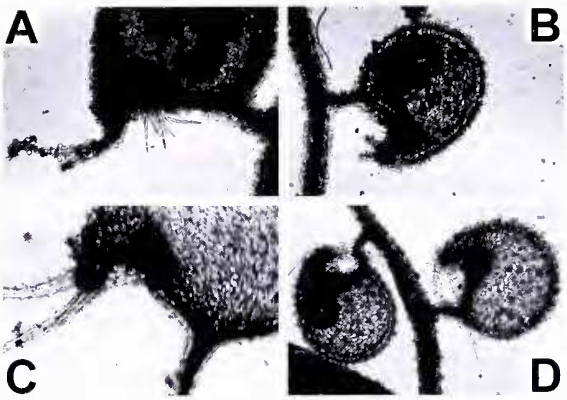

Figure 2: A: *Utricularia* 'Big Sister' bladder from water; B: *Utricularia* 'Big Sister' bladder from soil; C: *Utricularia* 'Enfant Terrible' bladder from water; D: *Utricularia* 'Enfant Terrible' bladder from soil.

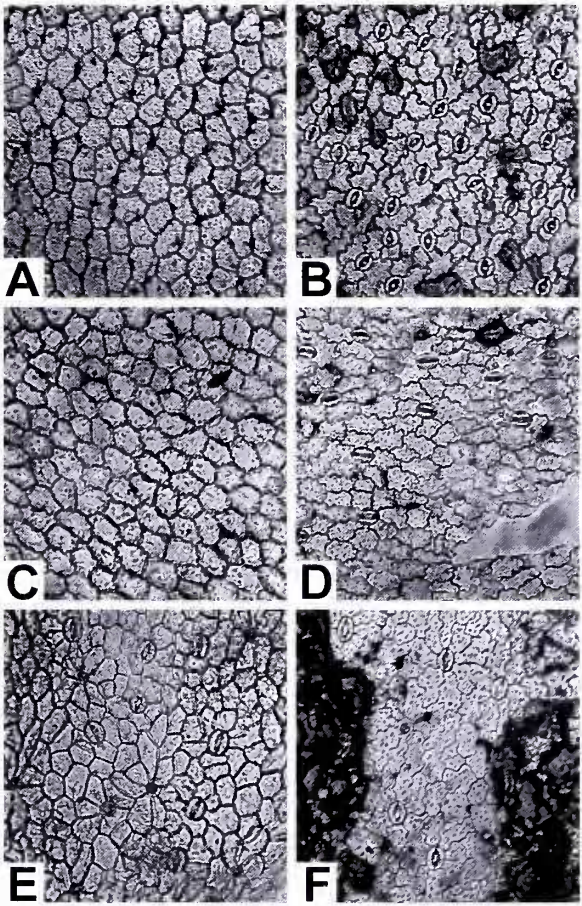

Figure 3: Leaf epidermis samples from *Utricularia reniformis*. A: *Utricularia* 'Big Sister' upper surface; B: *Utricularia* 'Big Sister' lower surface; C: *Utricularia* 'Enfant Terrible' upper surface of large leaf; D: *Utricularia* 'Enfant Terrible' lower surface of large leaf; E: *Utricularia* 'Enfant Terrible' upper surface of small ground leaf; F: *Utricularia* 'Enfant Terrible' lower surface of small ground leaf.

According to my field observations on the wet granitic slopes in Serra dos Órgãos, *Utricularia reniformis* 'Big Sister' depends upon the large lithophytic *Vriesea atra* for suitable habitat. However, this bladderwort can also survive outside of the bromeliad, growing well in soggy humus. I believe that the principal advantage to the lifestyle of growing in the bromeliad is realized for the seedling bladderworts. These floating plantlets benefit from the reliable supply of water in the central tanks of the voluminous bromeliads, quite similar to the case of *U. humboldtii* in the Guiana Highland. (This hypothesis is supported by the fact that the seeds of both species have green non-dormant embryos which germinate immediately in contact with water.)

Both of these plants inhabit bromeliads occurring in areas of cloud forest, especially in rock slope clearings. Mist is an important and reliable source of water, which is certainly the reason of the mentioned "aquatic" traps in *U. reniformis*, and, of course, also in *U. humboldtii*.

Utricularia reniformis does not have negatively geotropic stolons to reach younger parts of the hosting bromeliad, in contrast to the case with *U. humboldtii* (Studnicka, 2003). As a result, the stolons of *U. reniformis* occur within the basal senescent leaf sheaths of *Vriesea* only, where there is still plenty of water and planktonic lifeforms. The stolons also spread out of the bromeliad, growing independently thereafter in the moist humus. Once independent of its nascent bromeliad, the mature bladderwort can probably not invade a new bromeliad. The very tall flowering shoots of *Utricularia reniformis* apparently function to allow seeds to fall into new bromeliad urns and to germinate in the water standing therein.

The native ranges of the two types of *U. reniformis* discussed in this paper are not well documented. *Utricularia reniformis* 'Big Sister' occurs in Serra dos Órgãos, but also in Caminho do Mar near Sao Paulo (Lamb, 1992), and in so called campos rupestres, 1800 m, at Caraca, Minas Gerais State (Rivadavia, 1993). Information about the native range of *Utricularia reniformis* 'Enfant Terrible' is even more obscure. Based on the production of its epiphytic traps, I infer that the plant occurs in places with rather instable water conditions. Ule (1898) discussed a small variety of *Utricularia reniformis* (with a nomen nudum "*U. reniformis* var. *kromeri*") that was found growing in epiphytic bromeliads such as *Nidularium carolinae*, *Quesnelia lateralis*, a species of *Aechmea*, and *Vriesea hydrophora*, etc., in the Atlantic rain forest in Alto da Serra (max. alt. 1000 m) near Rio de Janeiro. These epiphytes are small, and their central water tanks may dry out periodically. This variety of *Utricularia reniformis* has not been relocated—is it identical with *Utricularia reniformis* 'Enfant Terrible'?

Conclusions

Two types of bladders (aquatic and epiphytic) were observed in *U. reniformis*. The aquatic bladders were regularly produced in *Utricularia reniformis* 'Big Sister', and only sporadically in *Utricularia reniformis* 'Enfant Terrible.' Epiphytic bladders were absent in *Utricularia reniformis* 'Big Sister,' but predominated in *Utricularia reniformis* 'Enfant Terrible.' The discrepancy of drawings from different authors (Luetzelburg, 1910; Taylor, 1989) was so explained.

The differences between the two cultivars of *Utricularia reniformis* are discussed in detail in Rice and Studnicka (2004), but to those observations (based upon leaf size and dimorphism) I have supplemented observations on the distribution of stomata. There are diacritical differences in the bladders of the two plants, expressed especially by the traps produced in soil.

The differences between the two cultivars are consistent and may ultimately support their classification as two species. More observations from their natural habitats are required, especially with respect to niche separation of the plants.

Utricularia reniformis 'Big Sister' was frequently observed in the field growing in leaf axils of a lithophytic bromeliad *Vriesea atra* at Pedra do Sino (Serra dos Órgãos). The symbiotic life strategy of this bladderwort—starting its life as a floating seedling in the central urn of the bromeliad—is very similar to *U. nelumbifolia* (cf. Goebel, 1893; Merl 1915, 1925; Studnicka, 2003). However, since *U. reniformis* does not produce an organ (such as an aerial shoot) to reach

the central urn of the bromeliad, with time it is relegated to the outer leaf axils of the bromeliad rosette. Ultimately, the plant spreads into wet humus and grows independent from the *Vriesea atra*.

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